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PEATLAND

A Malting Barley for the Gray Wooded Soil Areas of Alberta

BY

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INTRODUCTION

Of the 80,773,000 bushels of barley produced in Canada in 1932, 5,090,094 bushels were used by the malting and brewing industries. In the same year the barley crop for western Canada amounted to 63,557,139 bushels. Of this 5.2%, or 3,299,799 bushels, were used in the west for malting purposes. Approximately five million bushels of the western crop were shipped to eastern Canada, where doubtless a portion found its way into the malting industry.

There is an increasing demand for barley possessing malting quality, even though the bulk of the barley grown is used for feed. That the percentage of the cars graded as 3 Extra Canadian Western 6-Row, by the Inspection Department of the Board of Grain Commissioners for Canada, is gradually increasing is evident from the following data:

	3 Ex. C.W. 6-Row	
Crop Year.	Cars	%
1929-30	1,138	7.6
1930-31	1,103	7.5
1931-32	1,388	16.1
1932-33	2,328	28.7
1933-34	2,263	26.0
Aug., 1934, to Dec. 31, 1934	2,467	33.6

This would indicate that there has been a distinct improvement in the quality of barley grown in western Canada. Several factors are responsible for this change, but the primary cause is an attempt on the part of the producers to adjust supply to meet the greater demand for malting barley.

At the present time, a considerable premium exists for barley of malting quality, over the price being offered for the better types of feed barley. This spread is due largely to the fact that the United States has been importing large supplies of barley and malt from Canada to supplement her own stocks which have become greatly reduced by drought. So long as this demand exists the producer of malting barley may be assured of a sufficiently high price to justify the utilization of clean land and the necessary care in handling the crop, if malting grades are to be secured. The present price spread, however, cannot be expected to last more than a few years, since the increase in supply that will result from producers attempting to benefit from these higher prices will tend to lower the price offered for malting barley to a closer approximation to that offered for the better feed barleys. Furthermore, the shortage of malting barley in the United States is only a temporary situation which, in all probability, will be relieved if the producers of that country harvest a few normal crops.

The prospect at present for the grower of malting barley is one of fluctuating price levels. Stabilization of these prices may be brought about by limiting, in so far as possible, the growing of such barley to only those regions where the highest quality of product may be obtained. These regions have been found to comprise mainly the gray wooded soil areas of Alberta. For more detailed information on these soils see University of Alberta Bulletin No. 21, 1932. The low nitrogen content of these soils, together with the high precipitation they receive, allow for the production of a barley low in protein and high in starch content, an esssential characteristic of malting barley. The better or more fertile soil types, as exemplified by the black and brown loams, are much better adapted to the growing of high quality bread wheats than they are to the production of malting barley. Barley grown on these soils is too flinty and too high in protein content to meet the requirements of the maltsters.

It is also well to remember that, while the starch-developing propensities of the gray wooded soils produce a satisfactory malting barley, they produce with most varieties a low grade wheat of very poor milling quality. Hence it is to the advantage of farmers located on these soil areas to confine their cash grain-growing largely to the production of malting barley. Even in the event of a considerable decline in the price of malting barley, the returns to the grower will be as great, or greater, than that received by the grower of low grade wheat.

It is also a significant fact that the National Barley Committee, investigating the possibilities of raising the quality of Canadian-grown barley, have proposed the dividing of western Canada into zones, according to the protein content of the barley produced. Such a proposal, if carried out, should be very beneficial to producers of malting barley on the gray wooded soil areas, since it would be from such low protein areas that maltsters would purchase the greatest proportion of their supplies. In this way a steady market might be assured for malting barley.

The Requirements of Malting Barley

The standards established for malting barley are such, that considerably more care and intelligence must be exercised in the production and handling of the crop, than is the case when growing barley for feeding purposes. In order to get the proper viewpoint as to what constitutes satisfactory malting barley, it will be well to remember that the barley best suited for making malt is the barley which, when malted, will yield the greatest possible volume of free-starch. The importance of soil type in this regard has already been discussed. There remains, however, another important condition governing the amount of starch which may be obtained in a sample of malting barley, viz., the ripeness of the sample. In this connection it should be pointed out that the greater part of the starch in the barley kernels is laid down in the later stages of ripening. Hence, it is important that a barley crop intended for malting purposes be uniformly and well ripened. If cut on the green side, there is a sacrifice of starch content and mellowness. Starch in a partially developed condition cannot be reduced to a satisfactory malt.

The most fundamental phase of the malting operation is the germination of the sample. A strong, uniform germination is essential, and quick germination is desirable. To obtain these ends the sample must be sound, showing a reasonable brightness and no signs of injury from weathering, sprouting, heating or freezing. Furthermore, the sample should possess a minimum of skinned or broken kernels. Uniformity of size is also desirable in this regard.

It has been estimated that the largest cost in preparing barley for malting is the removal of impurities, such as weed seeds, other grains, broken kernels, chaff, straw, etc. The value or otherwise good malting barley is often considerably lowered by the presence in it of other grains. This is par-

ticularly true when the barley sample has admixtures of wheat. The similarity in shape, weight and size of kernels of these two grains renders thorough separation almost impossible.

Maltsters have found that notwithstanding the cultural methods employed in production, varieties differ in their suitability for making malt. Six-rowed rough-awned varieties are favored by Canadian maltsters, since they can be grown successfully for malting purposes over a much wider range of soil and climatic conditions than the two-rowed varieties. The standard malting barley for Canada at present is the well-known O.A.C. No. 21. Recent investigations conducted by the University of Alberta, with assistance from the Canada Malting Co., have shown that the variety, Peatland, possesses exceptionally high malting quality, when grown on the wooded soil. Despite the fact that the variety has been grown on a commercial scale in Alberta for one year only, so impressive has been its performance that numerous enquiries with regard to its characteristics are already being received. This circular is written with the purpose of supplying authentic information with regard to the characteristics of Peatland, particularly as they pertain to malting quality.

Origin of Peatland and Its Distribution in Alberta

Peatland was developed at the Minnesota Agricultural Experiment Station, St. Paul. It is a selection from material introduced from Switzerland. The variety was first introduced into Canada by the University of Alberta in 1929. Results of tests have shown Peatland to possess one outstanding agronomic characteristic, that of strong straw. The suitability of Peatland as a malting barley for the gray wooded soil areas was first recognized in 1931 when this variety, along with several others, was tested on the gray soil at Fallis, Alberta. Peatland appeared to be particularly well adapted to this soil type, being outstanding in the matter of strength of straw and general vigor of growth. Malting tests made in the same year by the Canada Malting Co. showed Peatland to excell in malting quality. Tests of a similar nature, conducted in 1932, 1933 and 1934, confirmed the results obtained in 1931. The Canada Malting Co. co-operated with the University of Alberta in the spring of 1934 in the distribution of sufficient seed to sow 40-50 acres on summer-fallowed land, at each of five different points on the gray wooded soil, in Alberta. Each of the fields was expected to produce a car load lot that

Fig. 1.—Standing crop of Peatland barley grown on summer-fallowed land, showing the erect growth at maturity, on the farm of J. Veitch, Fallis, Alberta, in 1934.

Fig. 2.—Same field as shown in Fig. 1, after cutting and stooking. Note the advantage of the stiff straw in building stooks. Courtesy of Colin Groff.

would be available for large scale malting tests. The fields were located at Bon Accord, Athabasca, Sangudo-Rochfort Bridge, Fallis (see Figures 1 and 2), and Warburg. Great satisfaction with the performance of the variety in the field was expressed by the growers at all five points. Preliminary malting tests of these crops were so satisfactory that the Canada Malting Co. decided to use all of the crop for seed. In co-operation with the Provincial Department of Agriculture, arrangements were made to ship the seed to Edmonton where it was cleaned, sacked and stored. Approximately 8,000 bushels were made available and distributed for the 1935 seeding.

Description of Head

Peatland is a white, six-rowed, hulled variety, possessing rough awns. The head is characteristically lax with the upper 6 or 7 later spikelets completely overlapping, forming four rows at the tip. The head also has a tendency to nod slightly at maturity. The kernels are generally smaller than those of O. A. C. No. 21 and possess an exceptionally thin hull. The aleurone layer is white and the rachilla beset with short curved hairs. The head and kernel characteristics of Peatland are shown in Figure 3.

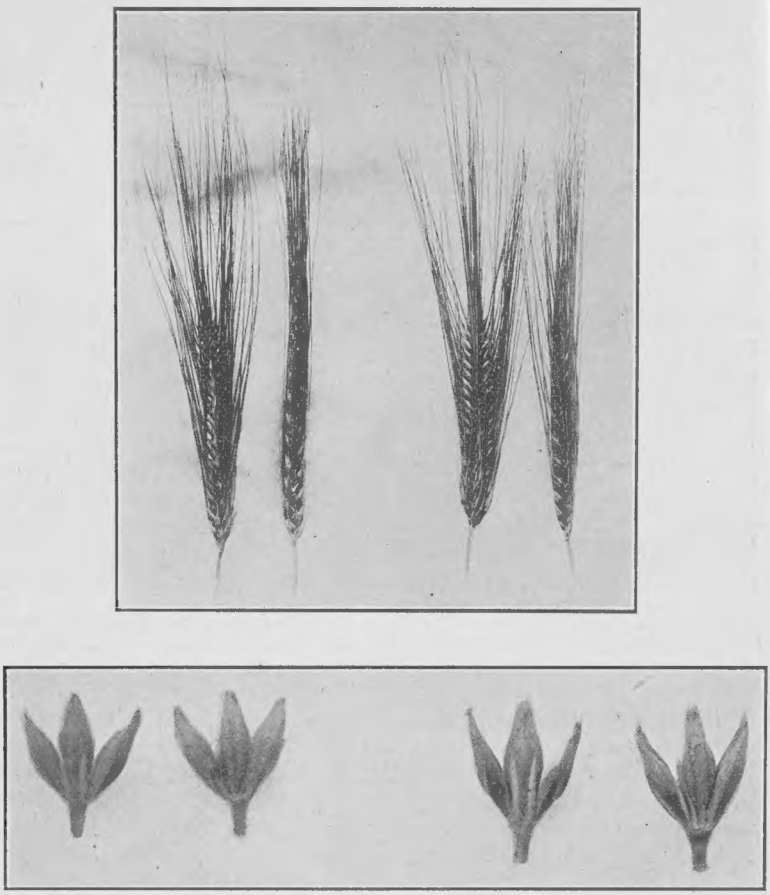

Fig. 3.—Showing the head and kernel characters of Peatland (left) and O.A.C. No. 21 (right) barley.

Experimental Results

The comparative data concerning Peatland and a number of other varieties of barley, were compiled from experimental plots located on three distinct soil types, viz., the black soil at Edmonton, the gray wooded soils at Fallis, and a peat soil at Westlock. The following agronomic characteristics will be considered: yield, strength of straw, earliness of maturity, height of plant, and weight per bushel. In addition to these agronomic characters, malting quality will also be discussed.

There are no facilities for conducting malting tests at the University of Alberta, consequently arrangements were made to have such tests carried out co-operatively with the Canada Malting Co. Their assistance is gratefully acknowledged and greatly appreciated.

Yield.

There has been a tendency in the past, when evaluating a cereal variety, to place undue emphasis on yielding capacity and to overlook other important characters which may possibly become limiting factors in the production of that particular variety. High yield is desirable provided that it is accompanied by characters that will tend to enhance the quality of the variety for whatever commercial use it is intended. Thus, when determining the value of spring wheat varieties, milling and baking quality must be considered as equally important as yielding capacity. Since the milling and baking quality of a sample of wheat is impaired by the presence in it of weathered, immature, frozen or diseased kernels, the varietal characteristics of early maturity, strong straw and disease resistance must be taken into account.

A similar condition exists in the case of the barley crop. When growing barley solely for feeding purposes to be used domestically, yield is probably the determining factor as to the variety that will be grown. When feed barley is grown, however, for export purposes, where a clean barley is demanded strength of straw becomes a character of prime importance. Clean barley can best be grown on summer-fallowed land, which in turn involves the use of strong-strawed varieties, if success is to be attained.

The requirements of malting barley, as already outlined, are such that yielding capacity becomes almost of secondary importance. Not only should the variety grown be capable of producing satisfactory malt, but the sample submitted for

malting should be clean and free from evidence of weathering, sprouting, heating, etc. It will be shown a little later in this circular that this state of perfection can most nearly be attained by the growing of strong-strawed varieties on summer-fallowed land.

In Table I are given the yield data for the two-year period, 1933-34, of Peatland and several other barley varieties, when grown on gray wooded soils at Fallis, Alberta. The yields in question were obtained from varieties grown on stubble land. The average yield of each variety has been expressed in terms of percentage of that of O.A.C. No. 21. These data show that Peatland yields practically on a par with O.A.C. No. 21, Glabron and Lapland. It is, however, distinctly inferior in yielding quality to Trebi. Trebi, however, is not favored by the Canadian maltsters.

TABLE I.

Comparative yields of Peatland and several other varieties of barley when grown on the gray wooded soils at Fallis, Alberta.

Variety	Yield in bushels per acre			
	1933	1934	Average	Yield in % of O.A.C. No. 21
Glabron	24.2	27.0	25.6	97
Lapland	23.0	31.0	27.0	102
Newal	24.6	24.0	24.3	92
O.A.C. No. 21	21.7	31.0	26.4	100
Peatland	24.2	28.0	26.1	99
Trebi	31.0	39.0	35.0	133

It is important to remember that the yield data just discussed were obtained from barley varieties grown on stubble land. The greater part of the malting barley will ,of necessity, be grown on summer-fallowed land in order to obtain the desired quality and freedom from weed seeds. Hence, the yield data presented above can be considered as giving only a partial picture of the comparative yielding capacities of these varieties, if grown on summer-fallowed land. Peatland has been found to give its best performance when grown on summer-fallowed land. A field of Peatland, grown by the University of Alberta at Edmonton in 1933, yielded an average of 78 bushels per acre. Since Peatland barley has no particular advantage over other varieties, except in strength of straw, when grown on the black soils, and since it is not recommended for the black soil area, the more complete data gathered on the experimental plots at Edmonton are not included. The data from the University farm at Edmonton have been published annually in the University of Alberta Press

Bulletin. The five 40-50 acre fields of Peatland grown on summer-fallowed land at different points on the gray wooded soils in 1934, gave yields of 45-62 bushels per acre.

One of the main reasons for the superiority of Peatland to other varieties, when grown on summer-fallow, lies in its characteristically strong straw (see Table II), which enables it to stand upright until harvest. The loss incurred by severe lodging from a weak-strawed variety often more than offsets any superior yielding capacity it may possess.

Strength of Straw.

The significance of the character strength of straw in a barley variety grown for malting purposes has been already mentioned briefly. Its importance in this connection is such as to warrant repetition. In the first place a good strength of straw allows for the production of clean barley, since the crop may be grown successfully on summer-fallowed land. In the second place it makes possible the production of a sound barley possessing a bright desirable color. Lodging exposes the crop to the extremes of weathering, which results invariably in discoloration, often in toughness or dampness and ocasionally in sprouting. If not properly dried tough or damp barley is liable to become heated, a condition which is very much discriminated against by the maltsters. Furthermore, the maturity of a lodged crop is delayed, thus increasing the likelihood of frost damage. Another important point that must be kept in mind is that a lodged crop seldom ripens uniformly. This causes a sacrifice of starch content since, as previously pointed out, starch development is an important function of the ripening process. A stiff straw is also of considerable advantage in the stooked grain. The ordinary stook of barley collapses as a rule after standing in the field and many of the heads rest on the soil, or are smothered within the stook. Under ordinary conditions the stooks of Peatland remain erect and produce a bright clear sample of grain. The erect stooks are well illustrated in Figure 2.

The percentage of lodging of Peatland, and that of a number of other barley varieties when grown on the black soil at Edmonton, and on a peat soil at Westlock, are given in Table II. Peatland possesses a particularly desirable strength of straw. On a four-year average (1931-34) it showed only 1% lodging when grown at Edmonton, as compared with 13% and 18% in the cases of the varieties O.A.C. No. 21 and Trebi respectively.

One of the greatest difficulties encountered in growing barley on peat soils, is the high percentage of lodging that occurs. A barley that will remain standing until harvest should prove a great asset to growers located on such soil types. Peatland appears to possess this necessary qualification to a considerable extent. This variety showed, on a two-year average, only 5% lodging when grown on a peat soil at Westlock; while O.A.C. No. 21 and Lapland showed 20% and 32% lodging, respectively.

TABLE II.

Comparative lodging of Peatland and several other varieties of barley when grown on the black soil at Edmonton, and on a peat soil at Westlock.

Variety	Lodging in per cent.							
	Edmonton (black soil)					Wetslock (peat soil)		
	1931	1932	1933	1934	Average	1933	1934	Average
Glabron	14	0	2	6	6	....	....	....
Lapland	....	0	10	23	11*	38	26	32
Newal	19	0	2	5	7	9	4	7
O.A.C. No. 21	32	1	14	5	13	23	16	20
Peatland	1	0	2	0	1	10	0	5
Trebi	52	1	5	14	18	....	....	....

*Average for 1932-34 only.

Earliness of maturity.

Earliness of maturity is a desirable character of any cereal crop grown in the gray wooded soil area. Earliness has been emphasized in barley because it is usually sown late as a cleaning crop. High quality barley will not be produced very often if grown as a cleaning crop. It should be sown early on clean land, in which case earliness is not of paramount importance. Earliness is desirable, however, in order that the variety may have wide practical usefulness. Not only is the danger of frost injury considerably reduced, but the crop may be permitted to stand for a greater length of time, thus allowing for maximum starch development.

From the data given in Table III, it will be seen that Peatland equals Trebi and Newal in growth period and averages only two days later than O.A.C. No. 21, when grown on the black soil at Edmonton. From general observations made at Westlock on peat soil, it appeared to be equal to O.A.C. No. 21 in earliness. General observations on the growth periods of the varieties grown on the gray soil at Fallis indicate Peatland to be slightly later than O.A.C. No. 21, but earlier than Trebi and equal to Glabron. Generally, Peatland shows a satisfactory growth period.

TABLE III.

Comparative growth periods of Peatland and several other varities of barley when grown on the black soil at Edmonton.

Variety	Growth period in days						
	Edmonton (black soil)						
	1930	1931	1932	1933	1934	Average	Days + or − O.A.C. No. 21
Glabron	85	107	85	78	88	89	+3
Lapland	....	....	79	74	80	78	−8
Newal	86	106	84	77	86	88	+2
O.A.C. No. 21	84	104	82	77	85	86	0
Peatland	84	105	83	78	89	88	+2
Trebi	85	109	84	77	87	88	+2

*Growth period is calculated by determining the number of days elapsing from emergence to maturity.

Height of plant.

The height of plant of any variety grown for malting purposes is not usually an important character provided it is not so short as to complicate harvesting. The data supplied in Table IV shows Peatland to possess a satisfactory length of straw. It is equal to O.A.C. No. 21 in this regard when grown on either gray wooded or peat soils.

TABLE IV.

Comparative heights of Peatland and several other varieties of barley when grown on the gray wooded soils at Fallis, and on peat soil at Westlock.

Variety	Height in inches					
	Fallis (gray wooded soil)			Westlock (peat soil)		
	1933	1934	Average	1933	1934	Average
Glabron	30	41	36			
Lapland	26	35	31	37	43	40
Newal	25	38	32	35	47	41
O.A.C. No. 21	28	39	34	40	52	46
Peatland	29	39	34	43	49	46
Trebi	21	29	25			

Weight per bushel.

A high weight per bushel of a barley sample is desired by maltsters, since it usually denotes a high degree of plumpness and a relatively small percentage of hull. From the data given in Table V, it will be seen that Peatland ranks highest in weight per bushel of the six-rowed varieties tested, when grown on either gray wooded or peat soils. The data compiled from the varieties grown on the gray wooded soil show Peatland to exceed O.A.C. No. 21 and Trebi by an average of 1½ and 3½ pounds per bushel, respectively.

TABLE V.

Comparative weights per bushel of Peatland and several other varieties of barley when grown on the gray wooded soils at Fallis, and on peat soil at Westlock.

Variety	Weight in pounds per bushel					
	Fallis (gray wooded soil)			Westlock (peat soil)		
	1933	1934	Average	1933	1934	Average
Glabron	53.0	50.5	51.5	.....	.....	....
Lapland	53.0	49.0	51.0	49.0	49.0	49.0
Newal	52.0	49.0	50.5	48.0	49.0	48.5
O.A.C. No. 21	53.0	51.0	52.0	47.0	51.0	49.0
Peatland	55.5	52.0	53.5	48.5	52.0	50.0
Trebi	51.0	49.0	50.0	.....	.....	.....

Malting quality.

Four important criteria are used in the determination of the capacity of a barley sample to produce good malt. These are outlined briefly below:

1. **Protein content.** Low protein content is desired, as it is associated with abundance of starch which may be converted into a relatively high proportion of sugar in the brewing process. A protein content of less than the usual 12β to 12.5β is desirable.

2. **Mellowness.** During the process of germination, the starch of the kernels is changed into a freer, or more available form, which is reflected in a crisp and friable condition of the malted kernels. Mellowness of the malt indicates that the modification of the starch has been complete. This factor is expressed on a percentage basis, a high percentage being desirable.

3. **Growth.** The germination process referred to above is stopped by drying before the young shoot, or acrospire, breaks out from under the seed-coat. The growth of this shoot, as determined by increase in length, in proportion to the length of the kernel, is used as a measure of the amount and uniformity of modification that has taken place. One hundred kernels of malt are examined and classified into groups with the acrospire having the following lengths in comparison with the length of the kernel: From 0-½, from ½-¾, and from ¾-1. A well modified malt will show 80-90% of the kernels in "¾-1" category.

4. **Amount of extract.** This constitutes the most important determination. It consists in measuring the amount of soluble material in the malt extract. A barley sample possessing 75% or more soluble material in the extract is said to be high in extract.

The comparative malting qualities of the three barley varieties: O.A.C. No. 21, Trebi and Peatland, when grown on the Edmonton black soil and on the Fallis gray wooded soils, are given in Table VI. It will be noted that the Fallis samples show lower protein content and higher mellowness and extract values than those grown at Edmonton. These results support the opinion that the more fertile types of soil are not entirely suitable for the growing of malting barley.

The data in Table VI also show Peatland to posses a very desirable malting quality, especially when grown on the gray wooded soil type. Of the three varieties compared, Peatland shows the lowest protein percentage and highest percentage of extract. It also exhibits high mellowness and growth values. Trebi has satisfactory protein content, but rather poor growth and mellowness values. O.A.C. No. 21 is satisfactory in all respects, with the exception of protein content, which is distinctly higher than the normal, 12-12.5%.

TABLE VI.

Malting quality of Peatland, O.A.C. No. 21, and Trebi barleys when grown on the black soil at Edmonton and on the gray wooded soils at Fallis, in 1932.*

Variety	Protein content	Growth			Mellowness	Extract (dry basis)
		0-½	½-¾	¾ up		
	%	%	%	%	%	%
EDMONTON (black soil)—						
O.A.C. No. 21	15.84	0	6	94	92	73.45
Peatland	17.35	0	4	96	88	71.40
Trebi	15.53	0	18	82	85	70.60
FALLIS (gray wooded soil)—						
O.A.C. No. 21	14.44	0	2	98	97	75.42
Peatland	10.97	0	4	96	96	77.26
Trebi	11.63	0	22	78	89	74.96

*Data kindly furnished by the Canada Malting Co.

In Table VII are presented the results of malting tests conducted on samples of Peatland grown on the five different farms in the wooded soil area, in 1934, to which reference already has been made. These data show conclusively the high malting quality of this variety. The samples from Bon Accord and Warburg possess normal protein content, while those from the other stations are even more satisfactory in this respect, showing protein contents of less than 11%. All samples, with the possible exception of that from Fallis, exhibit high growth and mellowness values. The percentage extract, which is the most important index of quality, is high in all five cases.

TABLE VIII.

Malting quality of Peatland barley when grown at five different points on the gray wooded soil in 1934.

Location of Farm	Protein content (dry basis)	Growth			Mellowness	Extract (dry basis)
		0-½	½-¾	¾ up		
	%	%	%	%	%	%
Bon Accord	11.93	4	12	84	97	76.17
Warburg	12.12	2	6	92	95	76.07
Fallis	10.77	10	22	68	81	75.94
Athabasca	10.12	8	10	82	88	77.30
Sangudo	10.89	4	6	90	88	76.26

SUMMARY

The requirements of malting barley are exacting that considerably more care must be exercised in the production and handling of the crop than is the case when barley is grown for seed purposes. Not only must the variety grown be capable of producing satisfactory malt, as judged by standards set up by the commercial maltsters, but the threshed samples must be free of weed seeds and admixtures; and be capable of rapid and vigorous germination. Vigor of germination is indicated by a reasonably bright color and freedom from damage by weather, sprouting, heating, frost, and mechanical injury.

Peatland, a six-rowed, rough-awned variety has been found to possess excellent malting quality. This variety has given its best performance with regard to both yield and malting quality when grown in the gray wooded soil area. One of the outstanding characteristics of Peatland is an exceptionally strong straw, which enables the variety to be grown on summer-fallowed land without great danger of lodging. This makes possible the production of a clean barley. Furthermore, a variety which will remain standing until maturity, and in the stook, is much less liable to become discolored and damaged by weather, frost, etc.

When grown on gray wooded soil, Peatland has proved to be approximately as early in maturity as O.A.C. No. 21, and to excel the latter in weight per bushel.

With the present price of malting barley, it seems that many growers located on the gray wooded soils, who are now growing inferior grades of wheat, could profitably turn their attention to the production of malting barley.